MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2018/2019

TMA 1301 – COMPUTATIONAL METHODS

(All sections / Groups)

6 March 2019
9 AM – 11 AM
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of **6 pages** only with **3 Questions.**
2. Attempt ALL **THREE** questions. The distribution of the marks for each question is given.
3. Please write your answers in the Answer Booklet provided, and **start each solution of a question on a new page.**
4. Show all steps.

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Question 1 (5 marks)

Suppose $f(x)=\dfrac{2-\sqrt{x}}{x-4}$.

(a) Compute $f(4.1)$ by using **four-digit arithmetic** with rounding.

[1 mark]

(b) Convert the function f into a form that avoid the loss of significance when x is near to 4 and denotes it as function $g(x)$.

[2 marks]

(c) Compute $g(4.1)$ by using **four-digit arithmetic** with rounding.

[1 mark]

(d) If the actual value of $f(4.1)$ is estimated to be -0.2485. Find the relative errors for values computed from (a) and (c).

[1 mark]

Continued.......

Question 2 (15 marks)

(a) You are asked to estimate the root of an equation $f(x) = 0$ using Newton`s method with initial guess at $x = p_0$.

(i) Use a graph to illustrate how the algorithm determines the next point p_1 from p_0. Hence, derives the algebraic formula for p_1.

[1.5 marks]

(ii) Approximate the root of equation $f(x) = x^3 + 5x^2 - 5 = 0$ starting at $p_0 = 1$ with tolerance 10^{-3}. Use **SIX** decimal places and show all the necessary working steps.

[3.5 marks]

(b) Suppose $y(x) = Ax + B$ is a line passes through points (x_1, y_1) and (x_2, y_2) and $h = x_2 - x_1$. Show that $\int_{x_1}^{x_2} y(x)dx = \frac{h}{2}[y_1 + y_2]$.

[2 marks]

(c) Approximate $\int_2^4 5\ln(2x^2 + 1)\, dx$ by using the Trapezoidal Rule with **five** points. Approximate your answer to **SIX** decimal places.

[3 marks]

Continued.......

(d) Approximate $\int_{2}^{4} 5\ln(2x^2+1)\,dx$ by completing the following table using Romberg algorithm. Approximate your answers to **SIX** decimal places.

[Hint: $R(n,m) = R(n,m-1) + \frac{1}{4^m - 1}\left[R(n,m-1) - R(n-1,m-1)\right]$, where $n \geq 1,\ m \geq 1$]

	$m=0$	$m=1$	$m=2$
$n=0$	$R(0,0)=$		
$n=1$	$R(1,0)=$	$R(1,1)=$	
$n=2$	$R(2,0)=$	$R(2,1)=$	$R(2,2)=$

[5 marks]

Continued.......

Question 3 (20 marks)

(a) Use row reduction technique to find an upper triangular **U** and lower triangular **L** in the **LU factorization** of the following matrix:

$$\begin{bmatrix} 3 & -7 & -2 & 2 \\ -3 & 5 & 1 & 0 \\ 6 & -4 & 0 & -5 \\ -9 & 5 & -5 & 12 \end{bmatrix}$$

[4.5 marks]

(b) Construct the equations for x, y and z of the following linear system. Then compute the three iterations for x, y and z using the **Gauss-Seidel Method.**

$$\begin{aligned} 4x - y - z &= 3 \\ -2x + 6y + z &= 9 \\ -x + y + 7z &= -6 \end{aligned}$$

Copy the following table into your **Answer Booklet** and **complete** it. Write your answers correct to **three** decimal places.

n	x	y	z
0	0	0	0
1			
2			
3			

[3.5 marks]

(c) Find the **eigenvalues** for the following **matrix** A:

$$A = \begin{bmatrix} 2 & 3 \\ 3 & -6 \end{bmatrix}$$

[2 marks]

Continued.......

(d) A 7-Eleven store manager notices that sales of soft drinks are mostly higher on hotter days and he records the data as in the following table.

Temperature in °F (x)	55	58	64	68	70	75	80	84
Number of cans sold (y)	340	335	410	460	450	610	735	780

(i) Copy the following table into your Answer Booklet and complete it.

x	y	x^2	xy
55	340		
58	335		
64	410		
68	460		
70	450		
75	610		
80	735		
84	780		
$\sum x =$	$\sum y =$	$\sum x^2 =$	$\sum xy =$

[2 marks]

(ii) From (i), find the equation of the best fit linear line $y = a + bx$ that models the data by using the ***least squares method***. Round your answers to **TWO** decimal place.

[Hint: $a = \dfrac{\sum_{i=1}^{n} x_i^2 \sum_{i=1}^{n} y_i - \sum_{i=1}^{n} x_i y_i \sum_{i=1}^{n} x_i}{n\sum_{i=1}^{n} x_i^2 - \left(\sum_{i=1}^{n} x_i\right)^2}$, $b = \dfrac{n\sum_{i=1}^{n} x_i y_i - \sum_{i=1}^{n} x_i \sum_{i=1}^{n} y_i}{n\sum_{i=1}^{n} x_i^2 - \left(\sum_{i=1}^{n} x_i\right)^2}$]

[2.5 marks]

(iii) From (ii), estimate the number of cans sold if the temperature is 95°F.

[0.5 mark]

Continued.......

(e) Given the following ***divided difference*** (DD) table of a function *f*.

x_k	y_k	First DD	Second DD	Third DD	Fourth DD
0	0				
1	1				
				1	
2	8				0
				1	
3	27				
4	64				

(i) Complete the above table.

[3.5 marks]

(ii) Hence, find the ***cubic Newton polynomial*** $P_3(x)$.

[1 mark]

(iii) Approximate $f(2.5)$ from the obtained $P_3(x)$ in (ii). Round your answer to three decimal places.

[0.5 mark]

End of Page